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JC13 Rec'd PCT/PTC 07 MAR 2002

Atty. Docket #: 1999/G-020

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INTERNATIONAL APPL. NO.: PCT/EP00/08539 :
INTERNATIONAL FILING DATE: -09/01/2000- :
APPLICANT: CARSTEN WOERNER ET AL :
SERIAL NO: (To be assigned) : **ART UNIT:**
FILED: -HEREWITH- : **EXAMINER:**
FOR: "POLYOXYMETHYLENE WITH IMPROVED :
RESISTANCE TO ACIDS :
AND ITS USE" :

Commissioner for Patents
Box PCT
Washington, D.C. 20231

"Express Mail" No.: EL 928737435

Date: - MARCH 07, 2002 -

I hereby certify that this paper, along with any other paper or fee referred to in this paper as being transmitted herewith, is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10, postage prepaid, on the date indicated above, addressed to the Commissioner for Patents, Washington, D.C. 20231.

- J. Lynn Ferry -
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J. Lynn Ferry
(Signature of person mailing paper)

**TRANSMITTAL OF APPLICATION PAPERS
TO U.S. DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. §371
(37 CFR 1.494 OR 1.495)**

This Transmittal Letter is based upon PTO Form 1390 (as revised in May, 1993).

The above-identified applicant(s) (jointly with their assignee) have filed an International Application under the P.C.T. and hereby submit(s) to the United States Designated/Elected Office (DO/EO/US) the following items and other information.

10/088656

JC01 Rec'd PCT/PTO 07 MAR 2002

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. §371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. §371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. §371(f)) at any time rather than delay.
4. ☒ A proper Demand for International Preliminary Examination (IPE) was made to the appropriate Authority (IPEA) within the time period required.
5. ☒ A copy of the International Application as filed (35 U.S.C. §371(c)(2)) --
 - a. ☒ is transmitted herewith (required when not transmitted by International Bureau).
 - b. ☐ has been transmitted by the International Bureau. See WIPO Publication WO 01/18114.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A (verified) translation of the International Application into the English language is enclosed.
7. ☐ Amendments to the (specification and) claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are transmitted herewith (required if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
 - e. ☐ will be submitted with the appropriate surcharge.
8. ☐ A translation of the amendments to the claims (and/or the specification) under PCT Article 19 (35 U.S.C. §371(c)(3)) is enclosed or will be submitted with the appropriate surcharge.

International Application No. PCT/EP00/08539.

1999/G-020

JC01 Rec'd PCT/PTO 07 MAR. 2002

9. ☒ An oath or declaration/power of attorney of the inventor(s) (35 U.S.C. §371(c)(4)) will follow.
☐ and is attached to the translation of (or a copy of) the International Application.
☐ and is attached to the substitute specification.

10. ☐ A translation of at least the Annexes to the IPE Report under PCT Article 36 (35 U.S.C. §371(c)(5)) is enclosed.

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98 is enclosed.
12. ☒ An Assignment for recording and a separate cover sheet in compliance with 37 CFR 3.28 and 3.31 will follow.
13. ☒ A FIRST preliminary amendment is enclosed.
A SECOND or SUBSEQUENT preliminary amendment is enclosed.
14. ☐ A substitute specification (including claims, abstract, drawing) is enclosed.
15. ☐ A change of power of attorney and/or address letter is enclosed.
16. ☒ Other items of information:

- ☒ This application is being filed pursuant to 37 CFR 1.494(c) or 1.495(c), and any missing parts will be filed before expiration of--

☐ 22 months from the priority date under 37 CFR 1.494(c), or

☒ 32 months from the priority date under 37 CFR 1.495(c).

- ☒ The undersigned attorney is authorized by the International applicant and by the inventors to enter the National Phase pursuant to 37 CFR 1.494(c) or 1.495(c).

The following additional information relates to the International Application:

10/088656

JC01 Rec'd PCT/PTO 07 MAR 2002

International Application No. PCT/EP00/08539

1999/G-020

- ☒ Receiving Office: EPO
☒ IPEA (if filing under 37 CFR 1.495): EPO
☒ Priority Claim(s) (35 USC §§ 119, 365):
 German Appln. 199 43 178.7 filed -September 09, 1999-
☒ A copy of the International Search Report is

☐ enclosed.

☒ attached to the copy of the International Application.

- ☒ A copy of the Receiving Office Request Form is enclosed. *

- [X] Form PTO/SB/05 (1) sheet
[X] Form PCT/IB/308 (1) sheet
*[X] Form PCT/RO/101 (4) pages

The fee calculation is set forth on the next page of this Transmittal Letter.

FEE CALCULATION SHEET

☒ A check in payment of the filing fee, calculated as follows, is attached (37 CFR 1.492).

Basic Fee..... \$ 890.00

Total Number of claims in
excess of (20) times \$18..... -0-

Number of independent claims
in excess of (3) times \$84 -0-

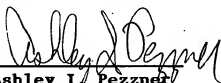
Fee for multiple dependent
claims \$280..... -0-

TOTAL FILING FEE... \$ 890.00

Kindly send us the official filing receipt.

The Commissioner is hereby authorized to charge any additional fees which may be required or to credit any overpayment to Deposit Account No. 03-2775. This is a "general authorization" under 37 CFR 1.25(b), except that no automatic debit of the issue upon allowance is authorized. An additional copy of this page is attached.

Respectfully submitted,

By 
Ashley I. Pezzner
Reg. No. 35,646
CONNOLLY BOVE LODGE & HUTZ LLP
1220 Market Street
P.O. Box 2207
Wilmington, Delaware 19899
Tel. (302) 658-9141

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Enclosures

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ATTORNEY DOCKET NO.: 1999/G 020 (5587*330)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: Carsten Woerner *et al.*)
)
SERIAL NO. TO BE ASSIGNED) ART UNIT: TO BE ASSIGNED
)
FILED: HERewith) EXAMINER: TO BE ASSIGNED
)
FOR: POLYOXYMETHYLENE WITH)
IMPROVED RESISTANCE TO ACIDS)
AND ITS USE)

Commissioner for Patents

Washington, D.C. 20231

"Express Mail" No. *EL 928737435 US*

DATE: *March 7, 2002*

I HEREBY CERTIFY THAT THIS PAPER OR FEE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE "EXPRESS MAIL POST OFFICE TO ADDRESSEE" SERVICE UNDER 37 CFR 1.10 ON THE DATE INDICATED AND IS ADDRESSED TO THE ASSISTANT COMMISSIONER FOR PATENTS, WASHINGTON, D.C. 20231

J. LYNN FERRY
(TYPED OR PRINTED NAME OF
PERSON MAILING PAPER OR FEE)

J. Lynn Ferry
(SIGNATURE OF PERSON MAILING
PAPER OR FEE)

PRELIMINARY AMENDMENT

Sir:

Prior to fee calculation and examination please amend the above-identified application as follows.

In the Claims

Please cancel claims 1 through 10.

Please add the following new claim(s).

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11. A polyoxymethylene comprising
 - A from 84 to 99.79% by weight of at least one polyoxymethylene homo- or copolymer,
 - B from 0.1 to 5% by weight of at least one polyalkylene glycol,
 - C from 0.1 to 10% by weight of zinc oxide, and
 - D from 0.01 to 1% by weight of one or more nitrogen-containing costabilizer.
12. The polyoxymethylene as claimed in claim 11, wherein the amount of polyalkylene glycol is from 0.5 to 5% by weight.
13. The polyoxymethylene as claimed in claim 11, wherein the amount of zinc oxide is from 1 to 3% by weight.
14. The polyoxymethylene as claimed in claim 12, wherein the amount of zinc oxide is from 0.5 to 3% by weight.
15. The polyoxymethylene as claimed in claim 11, wherein the nitrogen-containing costabilizer comprises at least one amino compound, amide compound, hydrazine compound, urea compound or a hindered amine.
16. The polyoxymethylene as claimed in claim 14, wherein the nitrogen-containing costabilizer comprises melamine.
17. The polyoxymethylene as claimed in claim 11, wherein the amount of nitrogen-containing costabilizers is from 0.03 to 0.3% by weight.
18. The polyoxymethylene as claimed in claim 16, wherein the amount of nitrogen-containing costabilizers is from 0.03 to 0.3% by weight.
19. The polyoxymethylene as claimed in claim 11, wherein test specimens in the form of ISO ¼ tensile specimens of thickness 1 mm produced from pellets obtained by melting and palletizing a mixture made from components A to D, which on each of five days in succession were fully immersed for 20 seconds in an aqueous solution made from 10% by weight of phosphoric acid and 1% by weight of an ionic surfactant, were then removed and, without wiping off any adhering acid/surfactant solution, aged freely suspended for 24 hours in an environment with controlled temperature and humidity, at 23°C and relative humidity of about 30%, and then aged for further 9 days suspended in the environment with controlled temperature and humidity, show a relative weight

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- difference of less than 15% compared with test specimens produced in the same way but not exposed to the acid/surfactant solution.
20. The polyoxymethylene as claimed in claim 19, wherein the relative change in weight of the test specimens made from components A to D is one third or less of the relative change in weight determined on test specimens made from 100% by weight of component A.
 21. The polyoxymethylene as claimed in claim 11, wherein said polyalkylene glycol is polyethylene glycol.
 22. The polyoxymethylene as claimed in claim 11, wherein said polyalkylene glycol is polypropylene glycol.
 23. The polyoxymethylene as claimed in claim 11, wherein said at least one polyoxymethylene homo- or copolymer is a homopolymer of formaldehyde or or trioxane.
 24. A molding for use in contact with aggressive acids or with aggressive acid-containing cleaning agents which is made from the polyoxymethylene as claimed in claim 11.
 25. The molding as claimed in claim 25, wherein the molding is used in the sanitary sector or the white goods sector.
 26. A method for improving the acid resistance of the polyoxymethylene homo- or copolymer which comprises making the polyoxymethylene as claimed in claim 11, by mixing components A-D together to form a mixture and then melting said mixture. --

REMARKS

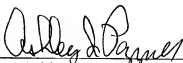
The applicants respectfully request that the preliminary amendment be entered prior to fee calculation and examination. The applicants have rewritten the claims in the proper U.S. form. Additional support for the claims can be found in the preferable language from page 4 of the specification. If there are any additional fees due in connection with the filing of this response, the Commissioner is authorized to charge or credit any overpayment to Deposit Account No. 03-2775.

ATTORNEY DOCKET NO.: 1999/G 020 (5587*330)

A prompt and favorable action is solicited.

Respectfully submitted,

CONNOLLY BOVE LODGE & HUTZ LLP

By 
Ashley I. Pezzullo
Reg. No. 35,646
Tel. (302) 888-6270

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WO 01/18114

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PCT/EP00/08539

Description**Polyoxymethylene with improved resistance to acids and its use**

5 The invention relates to polyoxymethylene molding compositions and polyoxymethylene moldings, both with improved resistance to acids, particularly to aggressive acid-containing cleaners, and also to their use, particularly in the sanitary sector or the white goods sector. In particular, it has been found that the acid resistance of polyoxymethylene can be increased without impairing its mechanical properties if zinc oxide is
10 present in the polyoxymethylene molding composition, in addition to polyalkylene glycol and nitrogen-containing costabilizers. The invention further relates to the production of moldings which are used in contact with aggressive acid-containing cleaners, for example in the sanitary sector or the white goods sector.

15 Due to their excellent mechanical properties and their good chemicals resistance, polyoxymethylenes (POMs, polyacetyls) have been used for many years, inter alia for many applications in the sanitary sector or white goods sector. The particular factors which predestine this material
20 for these areas of application are very good hydrolysis resistance, high dimensional stability, a balanced ratio or stiffness to toughness and excellent environmental-stress-cracking resistance.

25 However, cleaners used in households and on buildings have for some time tended to adopt more aggressive acid-containing formulations for faster action. In particular if these cleaners cannot be adequately removed by rinsing, drying and concentration can cause high concentrations of acid to occur on the surface of moldings, functional parts or other components (hereinafter grouped under the terms
30 moldings or products), and these concentrations can cause acidolytic corrosion.

There have been many different descriptions of methods for improving the acid resistance of polyoxymethylenes. An example of a customary
35 method is the incorporation of acid-resistant end groups and of comonomers to stabilize the polyacetyl chains in the POM polymer matrix (Becker/Braun, Kunststoffhandbuch [Plastics Handbook] vol. 3/1, Hanser Verlag 1992, p. 300 et seq.). Stabilization of this type is by no

means adequate for the acid resistance requirements described, since acid-catalyzed hydrolytic decomposition of POM can take place at any point within the polymer, and the protection given by stabilized end groups or comonomer units is therefore incomplete.

5

Another known method is to add low concentrations of proton acceptors such as alkaline earth metal salts of carboxylic acids, alkaline earth metal oxides or alkaline earth metal hydroxides, amines or other nitrogen-containing compounds (Becker/Braun, Kunststoffhandbuch [Plastics Handbook] vol. 3/1, Hanser Verlag 1992, p. 300 et seq., and Gächter/Müller, Kunststoffadditive [Plastics Additives], 3rd edition, Hanser Verlag 1990, p. 94 et seq.). This is also inadequate for the abovementioned increased requirements placed upon the acid resistance of polyoxymethylene. Since these components are basic in nature, adding higher concentrations merely causes severe discoloration of the POM matrix, but does not give the acid resistance desired.

10

15

EP-A 595 139 and EP-A 595 137 describe mixtures which give acid resistance, made from melamine cyanurate, alkali metal salts of polybasic acids, polyalkylene glycol and thermoplastic polyurethane (TPU). These stabilizing additives have a disadvantageous effect on the polyoxymethylene by way of discoloration, e.g. produced by alkali metal salts, and also by way of the fall in stiffness when TPU is added within the hardness range stated.

20

25

DE-A 44 42 723 describes the addition of carbodiimides to give acid resistance to polyoxymethylenes. However, it has been found that the resultant improvement in acid resistance is inadequate for long-term use in contact with highly aggressive acid-containing cleaners.

30

It was therefore an object of the present invention to find a polyoxymethylene molding composition which permits products produced therefrom to meet the increased requirements for resistance to acids, in particular to aggressive acid-containing cleaners, while at the same time retaining the excellent mechanical properties of the polyoxymethylene.

35

The present invention opens up a new way of achieving a marked improvement in acid resistance, while at the same time retaining the

mechanical properties of the polyacetals. The additives used for this comprise polyalkylene glycol, nitrogen-containing costabilizers and zinc oxide.

5 The invention therefore provides a polyoxymethylene with improved resistance to acids, comprising

- (A) from 84 to 99.79% by weight of at least one polyoxymethylene homo- or copolymer,
- (B) from 0.1 to 5% by weight of at least one polyalkylene glycol,
- 10 (C) from 0.1 to 10% by weight of a zinc oxide, and
- (D) from 0.01 to 1% by weight of one or more nitrogen-containing costabilizers,

where the total of the percentages by weight of components (A) to (D) is always 100%.

15

The invention also correspondingly provides the use of

- (B) from 0.1 to 5% by weight of at least one polyalkylene glycol,
- (C) from 0.1 to 10% by weight of zinc oxide, and
- (D) from 0.01 to 1% by weight of one or more nitrogen-containing
- 20 costabilizers,

20

with from 84 to 99.79% by weight of at least one polyoxymethylene homo- or copolymer (A), where the total of the percentages by weight of components (A) to (D) is 100%, for improving the acid resistance of the polyoxymethylene homo- or copolymer, or of moldings produced therefrom.

25

The invention further provides the use of the novel polyoxymethylene for producing moldings for applications in direct contact with aggressive acids, in particular with aggressive acid-containing cleaners.

- 30 Surprisingly, it has been found that adding polyalkylene glycol, nitrogen-containing costabilizers and zinc oxide in the proportions mentioned markedly reduces the weight loss from polyoxymethylene moldings in acid/surfactant mixtures, and at the same time retention of mechanical properties can be markedly improved. If, however, the amounts of
- 35 components B-D added is below the ranges mentioned, the resistance achieved is insufficient, while addition of excessive amounts affects the mechanical properties of the resultant moldings.

The base polymers (component A) used by the invention comprise the known polyoxymethylenes, as described in DE-A 2 947 490, for example. These are essentially unbranched linear polymers, which generally contain at least 80 mol%, preferably at least 90 mol%, of oxymethylene units
5 (-CH₂O-). The term polyoxymethylenes here includes both homopolymers of formaldehyde or of its cyclic oligomers, such as trioxane or tetroxane, and also corresponding copolymers.

Homopolymers of formaldehyde or of trioxane are polymers of this type
10 whose hydroxyl end groups have been chemically stabilized in a known manner, to resist degradation, e.g. by esterification or etherification. Copolymers are polymers made from formaldehyde or from its cyclic oligomers, in particular trioxane, and from cyclic ethers, cyclic acetals and/or linear polyacetals.

15 Comonomers which may be used are especially cyclic ethers having 3, 4 or 5, preferably 3, ring members, cyclic acetals other than trioxane, having from 5 to 11 ring members, preferably 5, 6, 7 or 8 ring members, and linear polyacetals. The proportion of the cocomponents in the polymer is
20 generally from 0.1 to 20 mol%, preferably from 0.5 to 10 mol%. The most suitable copolymers are those made from 95-99.5 mol% of trioxane and 0.5-5 mol% of one of the abovementioned cocomponents.

The proportion of the polyoxymethylene in the novel mixture is preferably
25 from 94 to 99% by weight.

The polyalkylene glycol (component B) preferably has an average molecular weight of from 1000 to 45,000, in particular from 5000 to 40,000. Its proportion in the mixture is preferably from 0.5 to 5% by weight,
30 particularly preferably from 1 to 3% by weight. Preferred polyalkylene glycols are polyethylene glycol and polypropylene glycol, particularly preferably polyethylene glycol.

The proportion of the zinc oxide (component C) in the mixture is preferably
35 from 0.5 to 5% by weight and particularly preferably from 0.5 to 3% by weight.

The nitrogen-containing costabilizers (component D) are selected from the group consisting of those amino costabilizers, amide costabilizers,

hydrazine costabilizers and urea costabilizers which are customary for polyacetals. These may be used individually or else in combination with one another. Hindered amines may also be used. However, particular preference is given to melamine. The proportion of the nitrogen-containing
5 costabilizers is preferably from 0.03 to 0.3% by weight.

The novel mixture may comprise the required amounts of other additives, such as anitoxidants, in particular hindered phenolic compounds, customary basic costabilizers, such as alkaline earth metal salts of
10 carboxylic acids, alkali metal oxides or alkali metal hydroxides, nucleating agents, antistats, light stabilizers, lubricants, plasticizers, pigments, dyes, optical brighteners, processing aids and the like. It is not advisable to add alkali metal salts of carboxylic acids, for the reasons mentioned above.

15 The total amounts usually used of the additives are from 0.1 to 5% by weight, in particular from 0.5 to 3% by weight, based on the entire molding composition. However, the amounts required may also differ from these, depending on the nature and makeup of the material.

20 The novel mixture may also comprise well known polymeric additives. To improve impact strength or sliding/friction properties it may comprise thermoplastic polyurethane elastomers, grafted polybutadiene core-shell modifiers, grafted acrylate core-shell modifiers, polytetrafluoroethylene, polyethylene, ultrahigh-molecular-weight polyethylene or grafted
25 polyethylene, for example. The total amount of these polymeric additives is usually up to 40% by weight, preferably up to 30% by weight, based on the entire mixture.

The novel mixture may moreover also comprise fillers and reinforcing
30 materials. These may, for example, be fibrous reinforcing materials, such as glass fibers, carbon fibers, etc., or else nonfibrous fillers, such as powdered glass, graphite, carbon black, metal powders, metal oxides, silicates, carbonates or molybdenum(IV) sulfide. These fillers may have been provided with a coupling agent or coupling agent system. The total
35 amount of fillers and/or reinforcing materials is usually up to 50% by weight, preferably up to 40% by weight, based on the entire mixture.

The novel mixtures may be prepared by customary and known processes, for example by intensive mixing of the constituents at an elevated

temperature, i.e. generally at temperatures above the melting point of component A, that is to say at from about 160 to 250°C, preferably from 180 to 220°C, in assemblies which give good mixing, such as kneaders or extruders, advantageously in twin-screw extruders. It is usual for the pulverulent components first to be mixed mechanically at room temperature and then melted for complete homogenization.

When additives, fillers or reinforcing materials are used it may, however, also be advantageous to use masterbatches or concentrates of these. Fibrous materials may also be introduced in continuous form, for example, into the mixing assembly, in particular into the extruder.

The novel polyoxymethylene has a balanced property profile. Moldings produced therefrom are particularly suitable for use in contact with aggressive acids and with aggressive acid-containing cleaners. In comparison with POM molding compositions which comprise none, or only one, of the components (B) to (D), the novel molding compositions give less chemical degradation and also less loss of mechanical properties, in particular after contact with aggressive acid-containing cleaners.

Possible fields of application include in particular fittings, flow modifiers, ventilation valves and functional parts of dishwashers, these being mainly produced from engineering plastics. The plastic components here come directly or indirectly via what is known as capillary action into contact with the aggressive media, and, depending on the ambient conditions, can be damaged relatively rapidly, with lasting impairment of their function.

Examples of these fittings are mixing cartridges in mixers (faucets) with single-handed lever operation, as mostly used nowadays in bathrooms or toilets. These cylindrical components permit precise setting of water temperature by regulating the flow of cold or warm water.

Flow modifiers are very finely structured flow formers which in modern water faucets and showerheads ensure that the stream of water emerging incorporates sufficient air to give it a foam-like consistency and prevent splashing. The flow modifier is generally the final component in the drinking water chain.

Ventilation valves are used in closed water-circulation systems, to remove volumes of air from the pipeline system as required. Particularly in systems using chlorinated water, the plastics used here have to have long-term resistance.

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Examples of the functional parts for dishwashers are retaining nuts for fixing the rotating spray arms, screening systems, such as the rinse-aid screen, outflow screen, etc., or wash-basket rollers, which ensure that the movability of these inserts is retained under load.

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Examples

The following components were used for the inventive Examples 5 and 8, and also for the Comparative Examples 1 to 4, 6 and 7:

15

Component A

Polyoxymethylene copolymer made from 96.6% by weight of trioxane and 3.4% by weight of dioxolane, stabilized with 0.3% of phenolic antioxidant and 0.2% by weight of tricalcium citrate. The melt volume rate was 8.0 cm³/10 min (190°C, 2.16 kg applied weight to ISO 1133).

20

Component B

Polyethylene glycol 12000 P from Clariant GmbH; polyethylene glycol with an average molecular weight of 12,000.

25

Component C: Zinkoxyd aktiv® from Bayer AG.

Component D1: Melamine, pure industrial grade.

30

Component D2: Melamine cyanurate, pure industrial grade.

Component D3: Tinuvin 770® hindered amine from Ciba Specialty Chemicals.

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The POM component (A) was mixed with the appropriate parts by weight of components (B)-(D) as in Tables 1 and 2, and melted in a ZE 25 x 33 D twin-screw extruder (Berstorff, Hanover, Germany) at a melt temperature of 200°C, and then pelletized.

The pellets were dried for 16 hours at 80°C and then injection molded to give ISO ¼ tensile specimens (in the earlier ISO 527) as test specimens for the resistance tests and mechanical tests. The processing conditions were selected in accordance with the recommendations in ISO 9988-2, the materials standard for POM. The use of ISO ¼ tensile specimens, which have a thickness of only 1 mm, rather than the type 1A tensile specimen (ISO 527-1,2) which has a thickness of 4 mm, is based on the fact that smaller specimens are markedly more effective for measuring material degradation and mechanical properties.

10

Aging and tests:

Prior to aging, five test specimens were weighed on each occasion for initial weight determination. Five other test specimens were tested as control specimens for determination of initial mechanical properties in the ISO 527 tensile test with an extension rate of 12.5 mm/min.

15

The weighed test specimens were freely suspended and completely immersed in an aqueous solution made from 10% by weight of phosphoric acid and 1% by weight of Mersolat H 40® (ionic surfactant from Bayer AG) in the case of Examples 1 to 5 and, respectively, 10% by weight of amidosulfonic acid and 1% by weight of Mersolat H 40® in the case of Examples 6 to 8. After about 20 seconds, the specimens were removed and, without wiping off adherent acid/surfactant solution, aged freely suspended for 24 hours in conditions of controlled temperature and humidity at 23°C and a relative humidity of about 30%. After these 24 hours, the same test specimens were again dipped for about 20 seconds in the acid/surfactant solution and then aged for 24 hours, again as described, without wiping off the solution. This immersion cycle was carried out on a total of five successive days. Following this, the specimens treated in this way were aged for a further 9 days suspended in the environment with controlled temperature and humidity. After this period of exposure to the increased-concentration acid/surfactant solution, 14 days in total, the five specimens were carefully wiped clean and reweighed. The weight difference relative to the initial weight was determined. The aged specimens were then used for a tensile test to ISO 527 with an extension rate of 12.5 mm/min.

35

Table 1 gives the makeup of the materials with the corresponding test results for immersion experiments in a solution made from 10% by weight of phosphoric acid and 1% by weight of Mersolat H 40®.

Table 1	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Example 5
Component A [% by weight]	100	99.8	97.8	97.0	96.9
Component B [% by weight]	-	-	2.0	2.0	2.0
Component C [% by weight]	-	-	-	-	1.0
Component D1 [% by weight]	-	0.2	0.2	-	0.1
Component D2 [% by weight]	-	-	-	1.0	-
Rel. weight difference [%]	-41.3	-28.4	-15.9	-17.1	-13.1
Elongation at break prior to aging [%]	72.9	69.4	70.4	46.3	72.7
Elongation at break after immersion experiment [%]	4.3	7.0	32.2	23.2	48.3

5

Adding components B, C and D within the given range of concentration significantly reduces degradation of the material. The best results, with the lowest possible loss of elongation at break and with little degradation of the material, are achieved with a combination according to the invention of components B, C and D1.

10

For the immersion experiment conditions selected, the change in weight is reduced to about 1/3 of the initial value (for 100% by weight of A), and the relative loss of elongation at break brought about by the immersion experiment is reduced from above 90% to about 30%. In the inventive

15

10

Example 5, there is virtually no change between the initial elongation and that of the unmodified material (Comparative Example 1).

- 5 Table 2 gives the makeup of the materials with the corresponding test results for immersion experiments in a solution made from 10% by weight of amidosulfonic acid and 1% by weight of Mersolat H 40®.

Table 2	Comparative Example 6	Comparative Example 7	Example 8
Component A [% by weight]	100	98.7	96.9
Component B [% by weight]	-	1.0	2.0
Component C [% by weight]	-	-	1.0
Component D1 [% by weight]	-	0.1	0.1
Component D3 [% by weight]	-	0.2	-
Rel. weight difference [%]	-33.7	-19.6	-14.4
Elongation at break prior to aging [%]	72.9	85.4	72.7
Elongation at break after immersion experiment [%]	0.1	4.6	20.7

- 10 Adding components B, C and D within the given range of concentration significantly reduces degradation of the material. The best results, with the lowest possible loss of elongation at break and with little degradation of the material, are achieved with a combination according to the invention of components B, C and D1.
- 15 For the immersion experiment conditions selected, the change in weight is reduced to less than half of the initial value (for 100% by weight of A), and the virtually complete loss of elongation at break brought about by the immersion experiment is markedly reduced. In the inventive Example 8, there is virtually no change between the initial elongation and that of the
- 20 unmodified material (Comparative Example 6).

Patent Claims

1. A polyoxymethylene with improved resistance to acids, comprising
 - 5 A from 84 to 99.79% by weight of at least one polyoxymethylene homo- or copolymer,
 - B from 0.1 to 5% by weight of at least one polyalkylene glycol,
 - C from 0.1 to 10% by weight of zinc oxide, and
 - 10 D from 0.01 to 1% by weight of one or more nitrogen-containing costabilizers,where the total of the percentages by weight of components A to D is 100%.
2. A polyoxymethylene as claimed in claim 1, wherein the proportion of polyalkylene glycol is from 0.5 to 5% by weight.
3. A polyoxymethylene as claimed in claim 1 or 2, wherein the proportion of zinc oxide is from 0.5 to 5% by weight.
- 20 4. A polyoxymethylene as claimed in any of claims 1 to 3, wherein the nitrogen-containing costabilizer used comprises at least one amino compound, amide compound, hydrazine compound or urea compound or a hindered amine, preferably melamine.
- 25 5. A polyoxymethylene as claimed in any of claims 1 to 4, wherein the proportion of nitrogen-containing costabilizers is from 0.03 to 0.3% by weight.
- 30 6. A polyoxymethylene as claimed in any of claims 1 to 5, wherein test specimens in the form of ISO 5 tensile specimens of thickness 1 mm produced from pellets obtained by melting and pelletizing a mixture made from components A to D, which on each of five days in succession were fully immersed for 20 seconds in an aqueous solution made from 10% by weight of phosphoric acid and 1% by weight of Mersolat H 40®, were then removed and, without wiping
35 off any adhering acid/surfactant solution, aged freely suspended for 24 hours in an environment with controlled temperature and humidity, at 23°C and a relative humidity of about 30%, and then

aged for a further 9 days suspended in the environment with controlled temperature and humidity, show a relative weight difference of less than 15% compared with test specimens produced in the same way but not exposed to the acid/surfactant solution.

5

7. A polyoxymethylene as claimed in claim 6, wherein the relative change in weight of the test specimens made from components A to D is one third or less of the relative change in weight determined on test specimens made from 100% by weight of component A.

10

8. The use of a polyoxymethylene as claimed in any of claims 1 to 7 for producing moldings for use in contact with aggressive acids or with aggressive acid-containing cleaning agents.

15

9. The use of moldings made from a polyoxymethylene as claimed in any of claims 1 to 7 for applications in the sanitary sector or the white goods sector.

10. The use of

20

B from 0.1 to 5% by weight of at least one polyalkylene glycol,
C from 0.1 to 10% by weight of zinc oxide, and
D from 0.01 to 1% by weight of one or more nitrogen-containing costabilizers,

25

with from 84 to 99.79% by weight of at least one polyoxymethylene homo- or copolymer (A), where the total of the percentages by weight of components A to D is 100%, for improving the acid resistance of the polyoxymethylene homo- or copolymer, or of moldings produced therefrom.

This polyoxymethylene is particularly advantageous when used for producing moldings for use in contact with aggressive acids or with aggressive acid-containing cleaning agents, in particular for applications in the sanitary sector or the white goods sector.

COMBINED DECLARATION AND POWER OF ATTORNEY

Attorney Docket No
1999/G 020 (5587*330)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

POLYOXYMETHYLENE WITH IMPROVED RESISTANCE TO ACIDS AND ITS USE
the specification of which

(check one) ☐ is attached hereto.

X was filed on September 1, 2000 as international application no. PCT/EP00/08539

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or (f) or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate, or §365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's or plant breeder's rights certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Claimed

<u>199 43 178 7</u>	<u>Germany</u>	<u>09/09/99</u>	<input checked="" type="checkbox"/> <input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes No
<u> </u>	<u> </u>	<u> </u>	<input type="checkbox"/> <input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes No
<u> </u>	<u> </u>	<u> </u>	<input type="checkbox"/> <input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes No

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

<u> </u>	<u> </u>
(Application No.)	(Filing Date)

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

<u>PCT/EP00/08539</u>	<u>01 September 2000</u>	<u>published WO 01/18114</u>
(Application Serial No.)	(Filing Date)	(Status)
		(patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

S03402

05/04/02

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) associated with **CUSTOMER NUMBER 23416**; all of **CONNOLLY BOVE LODGE & HUTZ LLP**, as attorneys with full power of substitution to prosecute this application and conduct all business in the Patent and Trademark Office connected therewith.

Send Correspondence To: Connolly Bove Lodge & Hutz LLP P.O. Box 2207 Wilmington, Delaware 19899-2207		Direct Telephone Calls To: (302) 658-9141	
FULL NAME OF SOLE OR FIRST INVENTOR Curtis Wornat		INVENTOR'S SIGNATURE	
RESIDENCE Germany		DATE	
CITIZENSHIP Germany			
POST OFFICE ADDRESS /quellke/strasse 5m 64747 Breunberg			
FULL NAME OF SECOND JOINT INVENTOR IF ANY Ursula Ziegler		INVENTOR'S SIGNATURE	
RESIDENCE Germany		DATE	
CITIZENSHIP Germany			
POST OFFICE ADDRESS Henry-Moisand-Strasse 40, 55130 Mainz			
FULL NAME OF THIRD JOINT INVENTOR IF ANY Kurt Witun		INVENTOR'S SIGNATURE	
RESIDENCE Germany		DATE	
CITIZENSHIP Germany			
POST OFFICE ADDRESS Zeil 17 a, 65719 Hofheim			
FULL NAME OF FOURTH JOINT INVENTOR IF ANY Klaus Kurz		INVENTOR'S SIGNATURE <i>Klaus Kurz</i>	
RESIDENCE Germany		DATE April 8, 2002	
CITIZENSHIP Germany			
POST OFFICE ADDRESS Rudolf-Bredisch-Strasse 2A, 65451 Kelsterbach			
FULL NAME OF FIFTH JOINT INVENTOR IF ANY		INVENTOR'S SIGNATURE	
RESIDENCE		DATE	
CITIZENSHIP			
POST OFFICE ADDRESS			
FULL NAME OF SIXTH JOINT INVENTOR IF ANY		INVENTOR'S SIGNATURE	
RESIDENCE		DATE	
CITIZENSHIP			
POST OFFICE ADDRESS			

COMBINED DECLARATION AND POWER OF ATTORNEY

Attorney Docket No
1999/G 020 (5587*330)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

POLYOXYMETHYLENE WITH IMPROVED RESISTANCE TO ACIDS AND ITS USE

the specification of which

(check one) ☐ is attached hereto.

X was filed on September 1, 2000 as international application no. PCT/EP00/08539

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I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or (f) or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate, or §365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's or plant breeder's rights certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed

<u>199 43 178.7</u>	<u>Germany</u>	<u>09/09/99</u>	<input checked="" type="checkbox"/> <input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes No
<u> </u>	<u> </u>	<u> </u>	<input type="checkbox"/> <input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes No
<u> </u>	<u> </u>	<u> </u>	<input type="checkbox"/> <input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes No

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below

<u> </u>	<u> </u>
(Application No.)	(Filing Date)

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

<u>PCT/EP00/08539</u>	<u>01 September 2000</u>	<u>published WO 01/18114</u>
(Application Serial No.)	(Filing Date)	<u>A1</u> (Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) associated with **CUSTOMER NUMBER 23416**; all of **CONNOLLY BOVE LODGE & HUTZ LLP**, as attorneys with full power of substitution to prosecute this application and conduct all business in the Patent and Trademark Office connected therewith.

Send Correspondence To: Connolly Bove Lodge & Hutz LLP P.O. Box 2207 Wilmington, Delaware 19899-2207		Direct Telephone Calls To (302) 658-9141
FULL NAME OF SOLE OR FIRST INVENTOR Carsten Woerner	INVENTOR'S SIGNATURE	DATE
RESIDENCE Germany		CITIZENSHIP German
POST OFFICE ADDRESS Apfelstrasse 50a 64747 Breuberg		
FULL NAME OF SECOND JOINT INVENTOR IF ANY Ursula Ziegler	INVENTOR'S SIGNATURE	DATE
RESIDENCE Germany		CITIZENSHIP German
POST OFFICE ADDRESS Henry-Monsard-Strasse 40, 55130 Mainz		
FULL NAME OF THIRD JOINT INVENTOR IF ANY Kurt Witas	INVENTOR'S SIGNATURE <i>Kurt Witas</i>	DATE 29.05.2002
RESIDENCE Germany		CITIZENSHIP German
POST OFFICE ADDRESS Zeil 17 a. 65719 Hofheim		
FULL NAME OF FOURTH JOINT INVENTOR IF ANY Klaus Kurtz	INVENTOR'S SIGNATURE	DATE
RESIDENCE Germany		CITIZENSHIP German
POST OFFICE ADDRESS Rudolf-Bredschied-Strasse 2A, 65451 Kelsternhach		
FULL NAME OF FIFTH JOINT INVENTOR IF ANY	INVENTOR'S SIGNATURE	DATE
RESIDENCE		CITIZENSHIP
POST OFFICE ADDRESS		
FULL NAME OF SIXTH JOINT INVENTOR IF ANY	INVENTOR'S SIGNATURE	DATE
RESIDENCE		CITIZENSHIP
POST OFFICE ADDRESS		

190766

COMBINED DECLARATION AND POWER OF ATTORNEY

Attorney Docket No.
1999/G 020 (5587*330)

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the specification of which

(check one) ☐ is attached hereto.

☒ was filed on September 1, 2000 as international application no. PCT/EP00/08539

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Prior Foreign Application(s)

Priority Claimed

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(Number)	(Country)	(Day/Month/Year Filed)	Yes No
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(Number)	(Country)	(Day/Month/Year Filed)	Yes No
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(Number)	(Country)	(Day/Month/Year Filed)	Yes No

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(Application No.)	(Filing Date)

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<u>PCT/EP00/08539</u>	<u>01 September 2000</u>	<u>published WO 01/18114</u>
(Application Serial No.)	(Filing Date)	(Status)
		(granted, pending, abandoned)

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FULL NAME OF SOLE OR FIRST INVENTOR Carsten Woerner	INVENTOR'S SIGNATURE	DATE
RESIDENCE Germany		CITIZENSHIP Germany
POST OFFICE ADDRESS Zapfenstrasse 5m 64747 Breunberg		
FULL NAME OF SECOND JOINT INVENTOR IF ANY Ursula Ziegler	INVENTOR'S SIGNATURE <i>U. Ziegler</i>	DATE 10-04-02
RESIDENCE Germany		CITIZENSHIP Germany
POST OFFICE ADDRESS Henry-Mossand-Strasse 40, 55130 Mainz		
FULL NAME OF THIRD JOINT INVENTOR IF ANY Kurt Witte	INVENTOR'S SIGNATURE	DATE
RESIDENCE Germany		CITIZENSHIP Germany
POST OFFICE ADDRESS Zeil 17 a, 65719 Heilheim		
FULL NAME OF FOURTH JOINT INVENTOR IF ANY Klaus Kurz	INVENTOR'S SIGNATURE	DATE
RESIDENCE Germany		CITIZENSHIP Germany
POST OFFICE ADDRESS Rudolf-Breitscheid-Strasse 2A, 65451 Kelsterbach		
FULL NAME OF FIFTH JOINT INVENTOR IF ANY	INVENTOR'S SIGNATURE	DATE
RESIDENCE		CITIZENSHIP
POST OFFICE ADDRESS		
FULL NAME OF SIXTH JOINT INVENTOR IF ANY	INVENTOR'S SIGNATURE	DATE
RESIDENCE		CITIZENSHIP
POST OFFICE ADDRESS		

190766

COMBINED DECLARATION AND POWER OF ATTORNEY

Attorney Docket No
1999/G 020 (5587*330)

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POLYOXYMETHYLENE WITH IMPROVED RESISTANCE TO ACIDS AND ITS USE

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Prior Foreign Application(s)**Priority Claimed**

<u>199 43 178.7</u> (Number)	<u>Germany</u> (Country)	<u>09/09/99</u> (Day/Month/Year Filed)	<input checked="" type="checkbox"/> <input type="checkbox"/> Yes No
<u> </u> (Number)	<u> </u> (Country)	<u> </u> (Day/Month/Year Filed)	<input type="checkbox"/> <input type="checkbox"/> Yes No
<u> </u> (Number)	<u> </u> (Country)	<u> </u> (Day/Month/Year Filed)	<input type="checkbox"/> <input type="checkbox"/> Yes No

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below

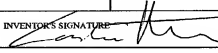
<u> </u> (Application No.)	<u> </u> (Filing Date)
--------------------------------------------------	----------------------------------------------

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<u>PCT/EP00/08539</u>	<u>01 September 2000</u>	<u>published WO 01/18114</u>
(Application Serial No.)	(Filing Date)	(Status) <small>(published, pending, abandoned)</small>

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) associated with **CUSTOMER NUMBER 23410** of **CONNOLLY BOVE LODGE & HUTZ LLP**, as attorneys with full power of substitution to prosecute this application and conduct all business in the Patent and Trademark Office connected therewith.

Send Correspondence To: Connolly Bove Lodge & Hutz LLP P.O. Box 2207 Wilmington, Delaware 19899-2207		Direct Telephone Calls To: (302) 658-9141	
1. FULL NAME OF SOLE OR FIRST INVENTOR <u>Carsten Wornat</u>	INVENTOR'S SIGNATURE 		DATE <u>25.3.02</u>
RESIDENCE: Germany			CITIZENSHIP Germany
POST OFFICE ADDRESS <u>Quellenstrasse 5, 64747 Dreieberg</u> DEX			
2. FULL NAME OF SECOND JOINT INVENTOR IF ANY <u>Ursula Ziegler</u>	INVENTOR'S SIGNATURE		DATE
RESIDENCE: Germany			CITIZENSHIP Germany
POST OFFICE ADDRESS <u>Henry-Mosand-Strasse 40, 55130 Mainz</u> DEX			
3. FULL NAME OF THIRD JOINT INVENTOR IF ANY <u>Kurt Watan</u>	INVENTOR'S SIGNATURE		DATE
RESIDENCE: Germany			CITIZENSHIP Germany
POST OFFICE ADDRESS <u>Zeil 17 a, 65719 Hofheim</u> DEX			
4. FULL NAME OF FOURTH JOINT INVENTOR IF ANY <u>Klaus Kurz</u>	INVENTOR'S SIGNATURE		DATE
RESIDENCE: Germany			CITIZENSHIP Germany
POST OFFICE ADDRESS <u>Rudolf-Breitscheid-Strasse 2A, 65451 Kelsterbach</u> DEX			
FULL NAME OF FIFTH JOINT INVENTOR IF ANY	INVENTOR'S SIGNATURE		DATE
RESIDENCE:			CITIZENSHIP
POST OFFICE ADDRESS			
FULL NAME OF SIXTH JOINT INVENTOR IF ANY	INVENTOR'S SIGNATURE		DATE
RESIDENCE:			CITIZENSHIP
POST OFFICE ADDRESS			

190766